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OBSERVATIONS ON THE EARLY STAGES OF TWO APHIDIINE PARASITES OF APHIDS.

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A few weeks ago some cocoons of Praon were discovered on a rose-bush brought to the Gypsy Moth Parasite Laboratory from a local greenhouse, and at the suggestion of Mr. W. F. Fiske, the opportunity was seized of making a brief study of the early stages of this common parasite of aphids.

Accordingly a small number of the cocoons was secured, and as the imagines emerged they were enclosed in a small glass cylinder with a sprig of rose and a few aphids. The females were not observed to mate with the males, but were frequently seen ovipositing in the plant-lice. The oviposition habits are like those of other Aphidiines as already described many times. The female bends the tip of her abdomen between her legs, and by a sudden trust darts it under her head into the abdomen of the helpless victim, completing the act in a moment of time.

By the dissection of parasitized aphids from these simple reproduction experiments, the eggs, first and second stage larvæ were easily secured, and the third stage larva was as readily obtained by opening fresh cocoons.

The eggs are undoubtedly placed one at a time in the abdomen of the host, and lie free among the organs and tissues beneath the integument. They are minute, ovoid bodies, white in color, of no special characteristic form or appearance. Like the eggs of *Platygaster* as observed by Marchal[1] they double and triple in size before hatching. This increase in size is able to take place, probably on account of the plastic nature of the chorion, which expands as the embryo grows by the absorption of food and fluids from the surrounding body fluids of the host.

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[1] Paul Marchal. Recherches sur le biologie et le développement des Hyménoptères parasites. Les Platygasters. Arch. Zoöl. (Paris), Vol. 4, pp. 485-640.

The first stage larva proved to be of unusual interest, and of specialized structure as is so frequently the case in first stage larvæ of hymenopterous parasites. A short description of it with an outline drawing will follow later in this paper. Its extraordinary tail-like appendages are probably respiratory in function, and the comb-like arrangement of bristles on the dorsum seems to indicate that it may thereby be able to move about among the organs and tissues of the host. The assumption that the bristles may aid in its locomotion is strengthened by the fact that they all point backward, are undoubtedly of sufficient size and firmness, and occur most abundantly on the posterior part of the body where they would be most useful.

After the first molt the larva loses its extraordinary appearance and assumes the form of the ordinary hymenopterous larva. During the second stage it increases rapidly in size and begins to make inroads upon the tissues of the host, though as yet carefully avoiding the vital organs. Finally in the third and last stage the larva quite destroys all the organs of the host, including the numerous embryo aphids which the mother aphid carries in her abdomen, and after sucking up the last juices, it leaves its host as a perfectly dry shell, in order to spin underneath a characteristic white cocoon, which has been figured and described by previous authors.[1]

Specimens of the *Praon* under observation were sent to the Bureau of Entomology at Washington and identified by Mr. H. L. Viereck as *Praon simulans* Prov. The aphid acting as host was likewise determined by Mr. Theo. Pergande to be the common rose-aphid *Macrosiphum rosæ* L. Another aphid common in the local greenhouse on carnations also proved to be host of this species though less frequently attacked.

From cocoons of Praon were obtained several species of secondaries. One a species of Encyrtid was obtained under such conditions as to make it extremely probable that this species does not attack the cocoons of Praon directly, but lays its eggs in the body of the aphid, where after hatching the larva would seek out the Praon larva, enter it and finally destroy it. Only one Encyrtid was reared from a cocoon.

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[1] For figure of cocoon see Howard, Insect Life, Vol. 4, p. 196.

From a number of cocoons collected from rose-bushes recently placed out of doors at the greenhouse, there was reared a species of Xystus of the family Figitidæ, and also a species of Pteromalid of the genus Asaphes.

While making observations on Praon at the greenhouse we found another species of the Aphidiinæ rather abundant and confining its attack principally to the above-mentioned species of aphid on carnation, though occurring less commonly on the rose-aphid. This species is possibly the European *Aphidius rosæ* Hal.

Encouraged by the interesting results with Praon we started reproduction experiments with this species and soon secured the early stages. The first stage larva proved to be far less specialized than that of Praon as it lacks the dorsal combs of bristles, and the tail-like appendanges. A description with drawing is appended with that of Praon.

Specimens of the aphid host were also collected at the greenhouse and dissected. The results are exceedingly instructive and may be tabulated as follows:

20 full-grown agamic female aphids dissected.
15 of the 20 or 75% were parasitized.[1]
10 of these 15 proved to be superparasitized.[2]
 5 contained two larvæ (in one case a larva and an egg).
 3 contained three larvæ (in one case a Praon larva).
 1 contained four larvæ.
 1 contained five larvæ.

Adding up the number of larvæ or eggs found in these 15 aphids we have a total of 33, only 15 of which could have ever reached maturity, leaving 18 to perish, more than three times as many needed to destroy the five unparasitized aphids, if the eggs had been distributed more equitably.

These results are the more remarkable when we consider that oviposition took place under normal conditions in a well-lighted and high-posted greenhouse, where host and parasite were free to follow the natural course of their instincts. They indicate how difficult or rather impossible it is for a parasite ever quite to exterminate its host, as some individuals, perhaps in more exposed positions, will be parasitized again and again, whereas others, probably less exposed, may escape destruction altogether.

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[1] Two of the fifteen parasitized aphids contained larvæ so far advanced that they had already destroyed every trace of any supernumerary larvæ that might have been present previously.

[2] See W. F. Fiske's paper, Superparasitism: an important factor in the natural control of insects. Jour. of Econ. Ent., vol. 3, no. 1, pp. 88–97.

An interesting problem that deserves more attention than we have had time to bestow upon it is the fate of the supernumerary larvæ. The few observations already made upon this point are, however, instructive. In most cases the supernumerary larvæ were apparently already dead, being sometimes somewhat disintegrated though bearing no marks of violence. As in all the cases where dead supernumerary larvæ were found there was still an abundance of tissues and liquids in the host for food, we cannot suppose that they were starved, nor, as there were no marks of violence found on them, can we suppose that they were killed in an active combat with a larger and older larva. We may be unwilling to believe that the more advanced and stronger larvæ secrete or excrete some fluid or material into the body of the host which eventually destroys their younger or weaker brothers and sisters, but this view seems forced upon us. This gains the more credence when we stop to consider that by some subtle influence the weak and often insignificant parasite frequently causes important pathological changes in the body tissues of its more powerful host. We have noticed this phenomenon not only in case of parasitized aphids, but also in caterpillars, notably in brown-tail caterpillars parasitized by Meteorus. The change we have in mind is the breaking up of the flaky fat-bodies into small, more or less globular bodies which are unattached and float freely in the body fluids. When in this condition the fatty tissues may be more accessible to the parasite as food.

In no case were the dead larvæ found surrounded and being destroyed by the phagocytes of the host, as we have lately observed in studies on the larvæ of Limnerium, the results of which we hope to publish shortly.

DESCRIPTION OF THE LARVAL STAGES OF PRAON AND LIPOLEXIS.

1. Praon simulans Prov.

FIRST STAGE LARVA: Body 14-segmented, somewhat tapering behind; last segment with a dorsal-median, cylindrical appendage nearly as long as the preceding segment, tipped with a few short hairs, and a pair of ventral appendages much more delicate, only about half as long as the dorsal appendage. The metathoracic and first to ninth abdominal segments provided with a comb of comparatively coarse bristles along their posterior margins; the comb extending nearly to lateral-ventral margins on the posterior, but becoming more and more dorsal on the anterior segments. Mouth-parts not prominent, though a pair of small but sharp and chitinized mandibles may be made out. Length .8 mm.

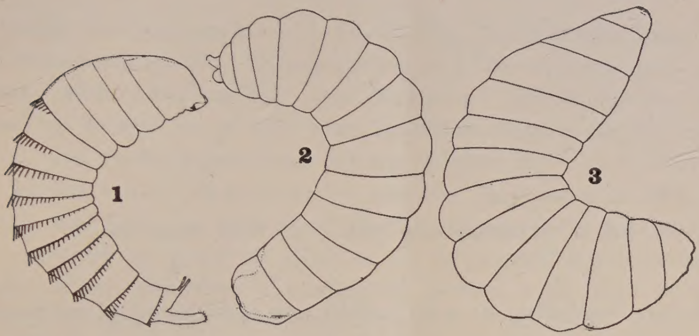

Fig. 1. *Praon simulans* Prov. 1, First Stage Larva; 2, Second Stage Larva; 3, Third Stage Larva.

SECOND STAGE LARVA: Like the ordinary hymenopterous larva. Body 13-segmented (owing to the fusion of the last two abdominal segments), tapering but little at both ends. Last segment broadly rounded, somewhat indented at the tip. Head small, mouth-parts appearing as fleshy folds. Integument of body delicate and smooth.

THIRD STAGE LARVA: Resembles the preceding stage, but tapers more at the anterior end. Head small, the mouth-parts represented by folds with chitinous plates, not at all prominent. Integument rather thick and chitinous, thrown into large folds along lateral margins of body, everywhere roughened by fine granulations. Length nearly 2 mm.

2. **Aphidius rosae** Hal. (?).

FIRST STAGE LARVA: Body 14-segmented, rather broad anteriorly and somewhat depressed, tapering gradually behind, the last segments rather deeply constricted, especially anteriorly. The head provided with a pair of projecting lobes on its posterior ventral margin on either side. Mouth-parts represented by a pair of comparatively long, curved mandibles, tipped with a yellowish spot, and prominent when protruded. Body smooth, free from hairs or bristles. Length .8 mm.

Second Stage Larva: Not readily distinguishable from the second stage larva of Praon.

Third Stage Larva: Very similar to same stage of Praon, except that it is slightly larger and head is more pointed. Length nearly 2 mm.

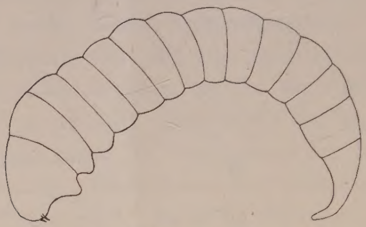

Fig. 2. *Aphidius rosæ* Hal. (?). First Stage Larva.

Before concluding we wish to take this opportunity of expressing our gratitude to Messrs. Viereck, Pergande and H. S. Smith for the determination of specimens.

TRICRANIA SANGUINIPENNIS SAY.

A female specimen of this species was taken on the under side of a piece of board in a sand pit in Framingham, Mass., April 16, 1905, and with it was a large mass of what I have considered to be the eggs. They are now very much shrunken and discolored but seem to be elongate oval in shape, measuring more than half a millimeter in length and about one third as wide.

The other inhabitants of this sand pit are *Cicindela rugifrons, C. generosa,* and possibly a few sand burrowing hymenoptera.

A male specimen of this beetle has recently been brought to me; this was also found in a sandy place. These two specimens are the only ones that I have seen from this locality.

C. A. Frost.

A NEW SPECIES OF APHOMOMYRMEX FROM BORNEO.[1]

By William Morton Wheeler.

Among the Camponotine ants of the Old World tropics there are two remarkable genera, *Aphomomyrmex* and *Dimorphomyrmex,* concerning which comparatively little is known. *Aphomomyrmex* was based by Emery[2] on *A. afer* from Kamerun, represented by male, female and worker specimens. He was in some doubt as to whether the worker, which had nine-jointed antennæ, was cospecific with the female and male, in both of which the antennæ were ten-jointed. He regarded the genus as allied to the neotropical *Myrmelachista* Roger, which comprises a number of species, with nine- to ten-jointed antennæ, and to *Dimorphomyrmex* Ern. André, which is represented by *D. janeti* described by Ern. André from Borneo[3] and *D. theryi* subsequently discovered by Emery in the Baltic amber.[4] *Myrmelachista* differs from *Aphomomyrmex* in having a differentiated antennal club in the worker and female, better developed frontal carinæ and more laterally placed eyes, while *Dimorphomyrmex* is peculiar in possessing large, reniform eyes in the worker and presumably also in the female, which is still unknown. *D. janeti,* according to André, has dimorphic workers, a large form (soldier) measuring 6 mm., with ocelli and a large, oblong head, and a small form (worker proper), measuring only 3.5 mm., without ocelli and with a proportionately shorter head. Emery says that he has seen a worker of this species from Sumatra measuring 4.5 mm. and therefore intermediate in size between the soldier and worker of Janet. This observation seems to indicate, as Emery has asserted, that the worker is really polymorphic in *D. janeti.* Through the kindness of Prof. R. Klebs and Prof. A. Tournquist I have been able to examine quite a number of specimens of *D. theryi* of the Baltic amber, but all of these were monomorphic.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 25.

[2] Fourmis d'Afrique, Ann. Soc. Ent. Belg. XLIII, 1899, pp. 493–496.

[3] Voyage de M. Chaper à Borneo. Catalogue des Fourmis et Description des Espèces Nouvelles. Mèm. Soc. Zoöl. France, V, 1892, pp. 49-51.

[4] Deux Fourmis de l'ambre de la Baltique. Bull. Soc. Ent. France, 1905, No. 13, pp. 188–189.

In 1894 Emery described a female ant from Borneo as *Dimorphomyrmex andrei*[1] with eight-jointed antennæ, but he concluded that this was an *Aphomomyrmex* after he had seen *A. afer*. Each of the two genera is therefore represented by two species, as follows:

Dimorphomyrmex Ern. André.

1. *D. janeti* Ern. André, Mém. Soc. Zoöl. France, 1892, pp. 49–51, Figs. 4 and 5, soldier, worker; Emery, Ann. Soc. Ent. Belg. XLIII., 1899, p. 494, *nota,* worker; Borneo; Sumatra.
2. *D. theryi* Emery, Bull. Soc. Ent. France, 1905, p. 188, Fig. 1, ♀; Baltic amber.

Aphomomyrmex Emery.

1. *A. afer* Emery, Ann. Soc. Ent. Belg. XLIII., 1899, pp. 493-496, 1 fig. worker, ♀ ♂; Kamerun.
2. *A. andrei* Emery. Ann. Soc. Ent. Belg. XLIII., 1899, p. 894, ♀ = *Dimorphomyrmex andrei* Emery, Ann. Soc. Ent. France, 1894, p. 73, ♀; Paulo-Laut, Borneo.

Among some Bornean ants collected and recently sent me by Mr. John Hewitt of the Transvaal Museum, I find two females and several workers of a third species of *Aphomomyrmex* of which I subjoin a description.

Aphomomyrmex hewitti sp. nov. (Fig. 1.)

Worker maxima. Length 3-3.5 mm.

Head flat, nearly as convex below as above, subrectangular, longer than broad, with straight subparallel sides, rounded posterior and blunt anterior corners. Eyes small, elliptical, flat, placed near the middle of the sides of the head and not on its upper surface. Ocelli present in some specimens but very small. Clypeus large, feebly convex behind, depressed in front, its anterior border rounded in the middle, not projecting, its posterior border not projecting back between the frontal carinæ to any appreciable extent. Frontal carinæ very small and short, the distance between them little more than half the distance between each of them and the corresponding lateral border of the head. Frontal area obsolete, frontal groove tenuous, but distinct. Mandibles small, with parallel internal and external borders and four sub-equal teeth; outer border with a blunt tooth near the base. Antennæ 8-jointed, short; scapes rather slender, straight, reaching only a short distance behind the eyes; first funicular joint slender, twice as long as broad, remaining joints slightly enlarged towards the tip of the antenna; joints

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[1] Descriptions de deux fourmis nouvelles. Ann. Soc. Ent. France, 1894, p. 73.

2-6 as broad as long, terminal joint shorter than the three preceding joints together. Thorax thickset, depressed, as long but not as broad as the head, broader in front than behind. Promesonotal and mesoëpinotal sutures distinct; mesonotum somewhat higher than the pronotum, feebly convex, forming a regular transverse ellipse. Mesoëpinotal constriction short but distinct, its bottom formed by the mesoëpinotal suture only. Epinotum a little broader than long, with feebly rounded sides, its base very short and horizontal, passing through a rounded angle into the much longer, sloping and flattened declivity. Petiole somewhat lower than the epinotum and only about one-third as broad, as long as high and wide, with an erect, transverse node, which has flat anterior and posterior surfaces and a rounded upper surface. Gaster very broadly elliptical, smaller than the head, flattened dorsoventrally, with well-developed anal cilia. Legs long and robust; fore femora somewhat incrassated; claws and empodia large.

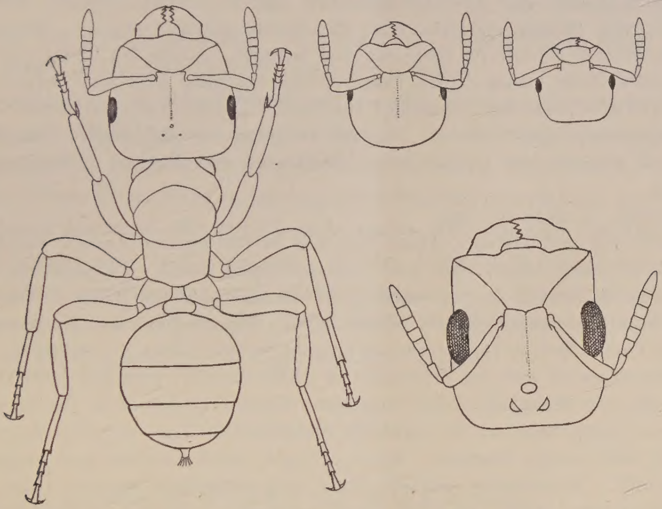


Fig. 1. Worker maxima of *Aphomomyrmex hewitti* sp. nov.; heads of worker media, worker minima and female, all drawn to the same scale.

Body shining. Mandibles, clypeus and cheeks subopaque, punctate and finely striate, except the middle of the clypeus, which is opaque and coarsely punctate. Head sparsely, thorax and gaster more densely punctate and less glabrous.

Hairs yellowish, rather long and abundant, erect or suberect on all parts of the body and appendages, including the antennal funiculi. Pubescence yellowish, sparse and rather long, distinct on the thorax and gaster only in certain lights.

Dark brown or black; mandibles, cheeks and clypeus deep red; articulations of legs and thorax, antennal funiculi and tarsi more yellowish.

Worker media. Length 2.8 mm.

Closely resembling the worker maxima, but the head is somewhat smaller and distinctly narrowed anteriorly, and the clypeus and cheeks are less deeply punctate and striate and therefore more shining. Ocelli absent. Antennal scapes reaching about half way between the eyes and the posterior corners of the head. Tooth on the external border of the mandibles obsolescent.

Worker minima. Length 2 mm.

Resembling the worker media, but the head is smaller, only a little longer than broad, as broad in front as behind, with feebly rounded sides, straight posterior border and rounded posterior corners. Ocelli absent. Clypeus convex and shining, its sides and the cheeks scarcely striate. Mandibles small, without a tooth on their external borders. Joints 2-6 of the antennal funiculi a little broader than long; scapes reaching half way between the eyes and the posterior corners of the head. Thorax not constricted in the mesoëpinotal region above. Gaster as large as the head. Mandibles, clypeus, antennæ and petiole yellowish like the articulations of the legs and thorax.

Female. Length 6-7 mm.

Body long and narrow. Head like that of the worker maxima but larger and with much larger eyes and well-developed ocelli. Clypeus very flat. Antennæ 8-jointed; scapes reaching about one-third the distance from the eyes to the posterior corners of the head. Second funicular joint as long as the first, which is fully twice as long as broad; joints 3-6 subequal, fully as long as broad and not increasing in width distally, terminal joint shorter than the two preceding joints together. Thorax as broad as the head, but twice as long, from above regularly elongate-elliptical, dorsally depressed, evenly and feebly rounded. Sides of neck much swollen and projecting anteriorly. Mesonotum and scutellum each somewhat broader than long; epinotum very feebly rounded above, uniformly sloping, without distinct base and declivity. Petiole nearly as high as the epinotum, as long as high and broad, its node thick and cuboidal in profile, seen from above transversely elliptical. Gaster elongate elliptical, nearly as large as the thorax. Legs long and stout, with large claws and empodia. Wings moderately long (6 mm.); venation as in *Plagiolepis.*

Sculpture and pilosity like those of the worker maxima.

Black; mandibles (except the teeth), clypeus, antennæ, tarsi, metanotum, anterior border of scutellum, articulations of the thorax, wings and legs, red; wings uniformly infuscated, with brown veins and blackish stigma.

Described from two females, six maxima workers, one media and one minina, taken by Mr. John Hewitt at Bidi, Borneo, during August, 1907, "in the swollen internode of a shrub." This remark, together with the strong development of the claws and empodia and the peculiar head of the maxima and female, so like the conditions in certain wood-inhabiting *Camponoti* and *Colobopsis,* shows that *A. hewitti* is a timid tree-ant, which habitually nests in small colonies in vegetable cavities.

Judging from Emery's decription, *A. andrei* must be very closely related to *hewitti,* but only the females of the two forms can be compared as the workers of Emery's species are unknown. The female of *andrei* is of a brown color and measures only 5-6 mm., its antennal scapes scarcely surpass the posterior borders of the eyes, the median joints of the antennal funiculi are broader than long and the petiole is longer than high and broader than long. In other respects the two species are very similar.

On comparing *A. hewitti* and *andrei* with Emery's description of *A. afer* one is tempted to conclude that the two Bornean species may be generically, or at least subgenerically distinct, since the African species differs from them in having three-toothed mandibles, nine- to ten-jointed antennæ, the eyes less laterally situated and the frontal carinæ longer and further apart. I have thought it best, however, not to place the Bornean and African species in different genera or subgenera till more material of the latter is available and till the males of the Bornean species are brought to light.

LEPIDOPTERA ON MILKWEED.

The following species of Lepidoptera were collected at Wales, Maine, July 11, 1904, with the aid of a common lantern, from the drooping flower heads of the milkweed (*Asclepius incarnata* L.): *Autographa rectangula,* three specimens; one specimen each of *Acronycta, innotata, Hadena vultuosa,* H. *remissa, Noctua lubricans, N. haruspica, Mamestra atlantica, M. subjuncta, Leucania insueta,* and L. *commoides;* several specimens each of *Euxoa redimicula, Acronycta interrupta, Heterophleps triguttaria,* and *Synelys enucleata.*

C. A. Frost.

THE FORMATION OF THE OOTHECA OF A CHINESE MANTIS, *HIERODULA SAUSSURII.*

By J. C. Kershaw.

This large and handsome Mantis, bright green in its wet season or summer dress, various shades of brown in dry season, appears almost invariably to construct its very complex ootheca during the night, or very early morning. They pair like locusts, the male clasping the female round the thorax with his forelegs. They seem to copulate two or three times for about three hours at a time on separate occasions during two or three days. After the last coupling, unless the male is very smart in disengaging himself, he is often caught and killed by the female, though he is not much smaller, being some two and one-half inches from the face to the tip of the abdomen. Once fertilized, the female makes four or more oothecæ at intervals of about twenty days, the first being made about nine days after the last coupling. It would seem, therefore, that the female is fertilized once for all. The oothecæ are made chiefly during September to January inclusive, i. e., mostly during the dry season or winter. They are constructed on tree-trunks, twigs, walls, boulders and many other objects. The female is fond, however, of getting a more or less vertical support against which to make the preliminary plates, besides a horizontal foundation for the floor of the ootheca. The oothecæ are fixed in all positions, both vertical and horizontal, but the female seems specially fond of working with her back downwards. Before commencing an egg-case, the Mantis is restless and keeps turning the abdomen (which is much swollen and heavy) laterally and letting it hang for some time first one side and then the other. She also walks slowly up and down, feeling various surfaces with the tip of the abdomen. Whilst making the ootheca the female grasps the twig or bark with her forelegs. The wings are closed and the tips held high above the back of the abdomen, out of the way. The cerci are incessantly used to gauge the outer dimensions of the case. One of ordinary size, say about an inch in length and containing perhaps two dozen egg chambers, takes two to three hours to complete. At first the colleterial matter is whitish, but is soon variegated with bluish and greenish; it afterwards turns brown, but for some hours it remains in a more or less soft condition. In a few days it becomes extremely hard and tough.

The oothecæ are parasitized badly by a species of *Dermestes,* whose larvæ destroy the whole interior. Besides this beetle, a small Hymenopteron (*Podagrion* sp.) and the larva of a moth are parasitic on Mantis eggs, and emerge by small round holes through various parts of the ootheca; but these parasites do not destroy the plates of the egg chambers, as the beetle larva does. At least seventy to eighty per cent. of the oothecæ are parasitized, and this is judging from several hundred egg-cases collected for some years over a very wide area.

The female has two sets of large colleterial glands, one set each side of the abdomen. They consist of long tubes, narrowing gradually to a blind end, and at the base uniting into one large, short duct; the two ducts of each set of tubes join in one large and very short duct opening into the dorsal side of the vagina. Close behind this duct are two small branching glands, also joining in a short, common duct. There is a large, globulate spermatheca.

The ootheca consists of two parallel rows of egg chambers (a row each side of the longitudinal center of the case, with about a dozen chambers in each row), the chambers of one side being half the depth of a chamber behind (or in front of) the chambers of the other side. Each chamber is formed by two plates, each plate forming the back of one chamber and the front of another. The plates overlap, a little beyond the vertical center, first one side and then the other, and are cemented together along this joint. At the top each plate expands laterally to the full width of the flaps, and a little higher still the cementing ceases and the flaps become free from each other. The flaps may be considered thin and flexible continuations of the plates, and are bent forwards at a rather sharp angle to form a protecting roof over the exits of the chambers. The sides or flanges of the chambers are formed by strips cemented around the outer edges of the plates. Outside the egg chambers is another covering or casing, formed by broad strips twisted at the top so as to attach to the base of the flaps; these strips overlap (or are received into) each other, and at the bottom are also twisted and broadened into feet, which also overlap one another and are cemented to whatever foundation the ootheca is being constructed upon. The feet of the egg plates (which also slightly overlap each other) rest upon and are cemented to the feet of the coverstrips — thus an air-space is left between the mass of egg chambers and the outer casing formed by the coverstrips. This air-space is, however, often roughly divided into cells by the ragged edges of the egg plates projecting between the flanges of the chambers, as indicated by dotted lines at 22, Fig. 5, Pl. 1. The coverstrips at the two ends of the ootheca are brought together and overlapped very much like the planking at the bows and stern of a boat. There are usually two or three roughly-formed smaller chambers, without eggs, at both ends of the egg-case. Those at the back end (increasing in size) form the foundation or support for the egg chambers proper; those at the front end (decreasing in size) bring the chambers gradually small enough to be closed by a single central plate (Cp, Fig. 2, Pl. 1).

In brief, the ootheca consists of an outer casing formed of overlapping coverstrips, within which are two parallel rows of egg chambers, so cemented together as to form a hard, tough mass.

The process of construction is somewhat as follows: A small plate (B, Fig. 2, Pl. 1) forming the back end of the ootheca having been cemented to the bark or other object, an outer coverstrip (CVS, Fig. 2, Pl. 1) is attached each side. Two or three more small but increasing plates are added, with their respective coverstrips, so that the feet of the latter now project forward some distance along the bark, and form a foundation for the feet of the egg plates. An egg plate (EP, Fig. 2, Pl. 1) is now formed against the last small plate (E, Fig. 2, Pl. 1), a flap (FL, Figs. 1 and 3, Pl. 1) is added, an outer coverstrip (CVS, Fig. 2, Pl. 1) attached, a closing membrane (CM, Fig. 1, Pl. 1) stuck on, and finally the eggs laid in the numbered order. After the eggs are laid and before the next egg plate covers them they are, nevertheless, covered with a thin film of colleterial matter, extending to the top of the closing membrane. The superabundant colleterial matter also becomes (by mutual pressure of eggs and egg plates) squeezed into the interstices between the eggs, forming little ridges or partitions between the eggs, rather deep near the outer edges or flanges of the egg plates, but altogether working out and disappearing in the central part of the egg plate, thus leaving a passageway for the nymphs from the lower eggs. The hollows where the eggs lie and the ridges between them are shown on the left-hand egg plate in Fig. 7, Pl. 2.

The insect next makes the egg plate and its concomitant parts for the egg chamber of the opposite row, and lays the eggs thereon. It next forms another egg plate over the eggs first laid, and thereafter adds a chamber alternately to each row until the whole batch of eggs is laid; then a few small, rough chambers decreasing in size and without eggs are added, and finally the ootheca is closed by one small central plate.

Turning to Pl. 2 and following the construction of an egg chamber in detail: An egg plate (Ep, Fig. 1) is first made; a flap (FL) is cemented on; a flange (FG, Fig. 2) is next cemented around the outer edge of the egg plate; then a coverstrip (CVS) is attached; and a closing membrane (CM, Fig. 3) renders the plate ready for the eggs. This closing membrane is a membraneous flap of colleterial matter, thin and flexible, which is cemented all around its edge to the egg plate, except across the top; it bulges outwards from bottom to top, where it rests against the egg plate next added, and thus closes the exit from the chamber; but it is easily thrust back against the back plate of the chamber when the nymphs are squeezing their way out. The mode of junction of the egg plates is shown specially in Fig. 7, Pl. 2, and Fig. 5, Pl. 1, where the joints are purposely left not quite touching, as in some of the other figures, for the sake of clearness, but of course they are really closely cemented together. At Fig. 4, Pl. 2, is shown a side view of an egg plate, without the coverstrip; at Fig. 5, Pl. 2, three coverstrips cemented together. At Fig. 6, Pl. 2, a vertical section through an egg chamber on the line c—d, Fig. 7. At Fig. 7 three egg chambers are shown in plan, the single chamber projected from Fig. 6. In Fig. 6, fl^2 is part of the flap of one of the chambers in the opposite row.

The shape of the flaps in transverse section is shown at UV, WX, YZ, Fig. 4, Pl. 1, representing sections across the flaps at about the heights of the corresponding lines in Fig. 3, Pl. 1. It will be seen that at YZ the flaps are joined or cemented together both at the ends and middles; at WX they are joined only at the ends; at UV they are altogether free. As the plates of the egg chambers in one row have flaps which are of equal breadth on either side of the longitudinal center of the ootheca, and as this is also the case with the chambers in the other row (which are half a chamber's depth behind or in advance) it follows that the flaps of the chambers on either side interlace. The lower edges of the two flaps forming an egg chamber are rigidly held on the outside of that row by two corresponding coverstrips; but the edge of the flap which comes across from the chamber of the opposite row and lies between the two former flaps is slightly within the full width and is left uncemented till a little lower down, and can thus be pushed slightly back by the emerging nymphs. Thus on each side of the row of flaps the lower edge of each flap is held rigidly or is semi-free alternately.

It may be added that some oothecæ are very small, having perhaps but six egg chambers; others have more than thirty, but the average length of an egg-case is about an inch, with about twenty-four chambers.

EXPLANATION OF PLATE 8.

Figure 1.

A, external side view, part of the exterior casing formed by the cover-strips broken away, exposing two egg chambers in the near row.

B, vertical section through longitudinal center.

C, vertical section (on line m—n, Fig. 3) through two egg chambers in the far row.

D, external side view of back end.

ec, egg chambers in far row.

ec,^{2} egg chambers in near row.

cm, closing membrane.

Figure 2.

A^1, external top view.

cp, cover-plate.

B^1, external top view, the flaps cut away as at UV.

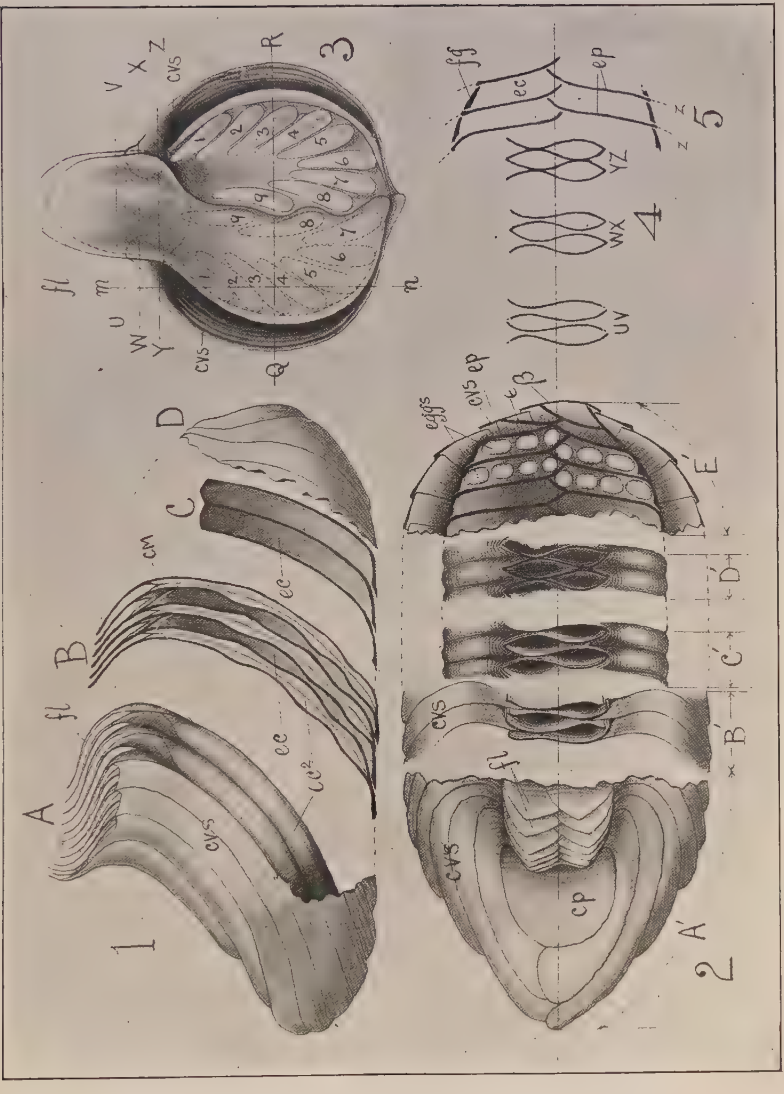
C^1, top view, outer casing removed, flaps cut away as at WX.

D^1, top view, outer casing removed, flaps cut away as at YZ.

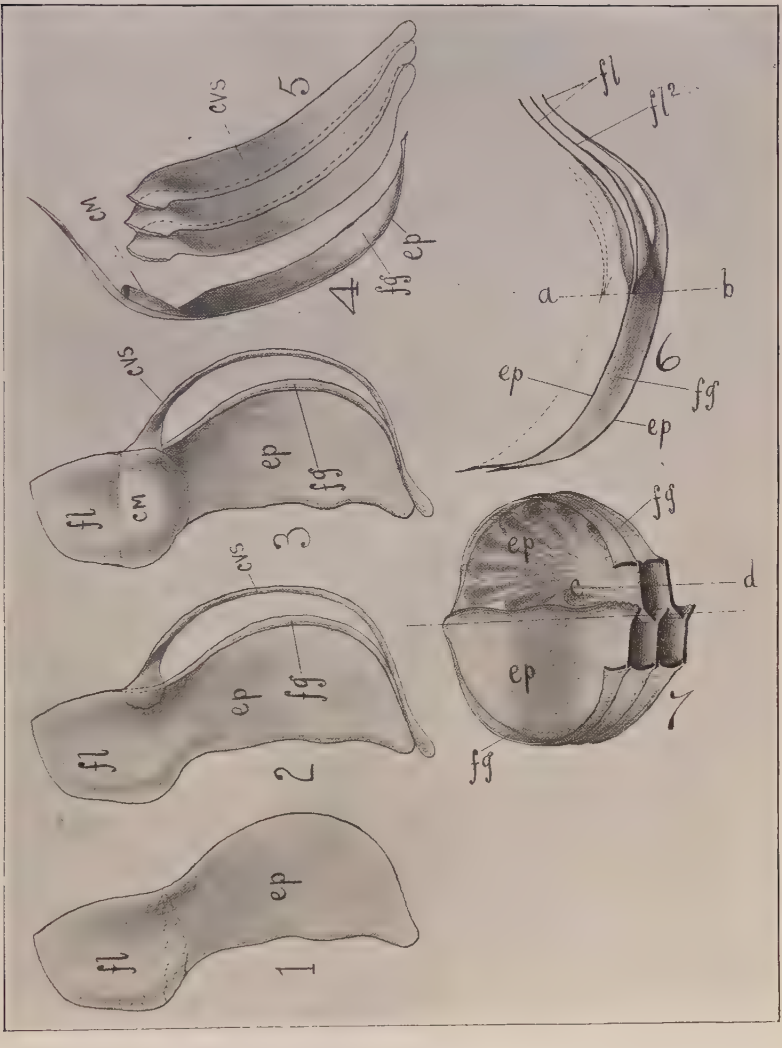
E^1, horizontal sections (on line Q—R, Fig. 3) through egg chambers.

e, last small plate forming rough chamber without eggs.

B, cover-plate.



KERSHAW—OOTHECA OF HIERODULA SAUSSURII.



KERSHAW—OOTHECA OF HIERODULA SAUSSURII.

Figure 3.

Transverse view about the middle of the ootheca. The covering plate of the right-hand chamber removed. The flange, coverstrip and closing membrane not yet attached to the left-hand plate. The tips of the flaps are shown more or less straight up, instead of bent sharply forwards, as they are naturally.

1, 2, 3, etc., the eggs laid in the order of their numbers.

Figure 4.

UV, section of flaps through line UV, Fig. 3.
WX, section of flaps through line WX, Fig. 3.
YZ, section of flaps through line YZ, Fig. 3.

Figure 5.

Horizontal section through egg chambers of the back end of the ootheca, about the line Q—R, Fig. 3. zz, ragged edges of egg plates, which sometimes project between the flanges.

In all the figures of this plate: fg=flange; fl=flap; cvs=coverstrip; ep=egg plate; ec=egg chamber.

EXPLANATION OF PLATE 9.

Fig. 1, egg plate and flap cemented together.
Fig. 2, same, flange and coverstrip added.
Fig. 3, same, closing membrane added.
Fig. 4, same side view, but coverstrip not shown.
Fig. 5, three coverstrips cemented together.

Figure 6.

Vertical section through left-hand chamber, on line c—d, Fig. 7.

Fl^2, flap coming across from a right-hand chamber.

Figure 7.

Top view of three egg chambers, the upper part cut away about the line a—b, Fig. 6.

In all the figures of this plate: ep=egg plate; fl=flap; fg=flange; cvs=coverstrip; cm=closing membrane.

SOME NEOTROPICAL BEES.

By T. D. A. Cockerell.

Hemisia lanipes (Fabr.).

Antigua, West Indies (*C. A. Barber*) Brit. Museum.

Hemisia semilabrosa sp. nov.

♀. Length 13½ mm.; almost exactly like *H. labrosa* (Friese), but the labrum, though longer than in *H. lanipes,* is still evidently broader than long; the clypeus is smooth and very sparsely punctured, with the median third concave; the abdomen is entirely clear red; the hair on the inner side of the hind basitarsus is very dark chocolate, but that on the outer side of the hind legs is pale reddish. The concave clypeus suggests *H. montezuma* (Cress.). Labrum notched at apex, pale yellow with two oval pale brown marks; mandibles pale yellow basally, a minute elevation on inner side toward the base, and the apical half with three teeth, the large apical one, a small one projecting from its side, and a large sharp tooth on inner side not far beyond the middle; under side of head with long white hair; eyes straw-yellow, rather narrowly fuscous in front; scape short, dark; flagellum dark ferruginous beneath except at base; front with pale yellowish-grey hair more or less tipped with fuscous; vertex with black hair; thorax above with short light greyish-brown hair tipped with fuscous; at sides the hair is pale ochraceous, not dark-tipped; tegulæ pale testaceous; wings dilute smoky, nervures black, venation practically as in *lanipes;* legs dark, with pale reddish hair, the hind tibiæ, and middle and hind tarsi, becoming ferruginous; anterior and middle basitarsi each with a longitudinal, curved, sharp keel on anterior margin toward the inner side; anterior and middle knees with a small pale yellow spot; the scanty hair of abdomen rufofuscous, clear red at apex. General appearance like *H. lanipes,* but larger, with the two large yellow marks on the clypeus triangular.

Hab.—Ecuador (*Rosenberg*). British Museum, 99–104. In Friese's table of the subgenus *Rhodocentris* this runs nearest to *H. tarsata* (Smith), which is only known in the male. *H. tarsata* comes from Santarem, and is only 9½ mm. long, and otherwise seems distinct from *H. semilabrosa.*

Agapostemon swainsonae sp. nov.

♂. Length about 8 mm.; head and thorax brilliant green, abdomen and legs dull ferruginous; front and mesothorax smooth and shining, with a very strong golden lustre, the sculpture consisting of delicate weak striæ and very minute and sparse punctures; clypeus prominent, with an obtuse but strong median ridge; at each side of the clypeus, toward the apex, is a small shining black tubercle, and the apical margin is broadly pale yellow, the labrum, and mandibles except apex, being of the same color; hair of face and vertex strongly tawny, of cheeks dull white; scape yellow in front; flagellum dark ferruginous above, light ferruginous beneath, the apical half crenulate; scutellum smooth and shining, with very minute punctures; pleura roughened anteriorly, strongly striate posteriorly; metathorax without any defined enclosure or sharp margin round the apical truncation, the whole surface strongly striate, the striæ oblique, those on the truncation approximately at right angles to those on the part above; sides of metathorax with pale yellowish coarsely plumose hair; tegulæ pale rufo-testaceous; wings rather dusky, stigma and nervures dark brown, first r. n. joining second s. m. far beyond the middle; legs ferruginous, the hind femora greatly swollen, dusky above, with a broadly triangular tooth beneath toward the apex; hind tibiæ thick, the inner edge sharp; hind basitarsi with a prominent obtuse tubercle beneath; abdomen dark ferruginous with a slight purplish (not metallic) tint, the hind margins of the segments broadly paler.

Hab.—Jamaica (*Mrs. E. M. Swainson*). Brit. Museum. Nearest to the Cuban *A. femoralis* Guérin, but easily known by the smooth, shining mesothorax and scutellum.

Augochlora regina Smith.

♀. Jamaica; "P. G. R., St. Thomas, June." (*Mrs. E. M. Swainson*). Brit. Museum.

Coelioxys foxii Viereck.

♂. Kingston, Jamaica, Nov., 1893. Brit. Museum.

Melissa friesei Ducke.

♂. Brazil (*W. H. Bates*); F. Smith collection. Brit. Museum. Although long ago discovered by Bates, this beautiful species was not described until 1902. The specimen before me has the abdomen brilliant blue; Ducke's description says "nigrocæruleus." The bifid spur of the middle tibia has the anterior branch quadridentate, a fact not indicated by Ducke, and the specimen is a little smaller than Ducke's type. It is just possible that actual comparison would indicate that our insect is separable, but except for the points mentioned, the structural and color characters are all in accord with *M. friesei*. *M. maculata* Friese must be closely allied.

M. decorata Smith was described from "Brazil." The original specimens were taken by Bates in S. Paulo.

Mesocheira bicolor (Fabr.).

A female in the British Museum, labelled "Guiana," is only 10 mm. long.

Isepeolus octopunctatus (Jörgensen).

Jörgensen described this species (under Epeolus) in 1906 from a single female. Two of the same sex are in the British Museum, from Patagonia (V. del Lago Blanco, *Chubut*). They agree with the original description, except that they show two more small white spots on the abdomen, on the hind margin of the fourth segment. In one of the specimens these spots are barely visible. Jörgensen remarks that his species is allied to *E. luctuosus* Spinola. From the particulars given by Jörgensen and F. Smith, I suspect that *Isepeolus albopictus* Ckll. may not be separable from *I. luctuosus* (Spin.), the latter being no doubt an *Isepeolus*. It is to be noted, however, that *I. luctuosus* was described from Chile, and was considerably smaller than *I. albopictus;* it is not unlikely that there are two species, one Chilian and the other in the Argentine, the latter being really *albopictus,* though recorded by Jörgensen as *luctuosus*. The genus *Calospiloma* Brethes, based on *Epeolus viperinus* Holmg., can hardly be separated from *Isepeolus,* unless the tridentate mandibles may suffice for the purpose. Brethes refers *I. luctuosus* to *Calospiloma.*

THE CHALCIDOID PARASITES OF THE COMMON HOUSE OR TYPHOID FLY (*MUSCA DOMESTICA* LINN.) AND ITS ALLIES.[1]

III. Description of a New North American Genus and Species of the Family Pteromalidae from Illinois, Parasitic on *Musca domestica* Linn., with Biological Notes.

By A. A. Girault and George Ethelbert Sanders,

The University of Illinois.

The type species of this new and important genus of the pteromaline tribe Eutelini, was in point of numbers, third among the chalcidoid parasites reared by us during the investigations of the common house fly, during the latter part of the season of 1908, it being less numerous than species of Spalangia and the parasite *Nasonia brevicornis* Ashm. Unlike the latter, however, it was not reared independently or from a number of hosts, but nearly always occurred in connection with some one of the species of *Spalangia* and we were inclined to believe, though the evidence was lacking, that it usually attacked that genus, and hence is a secondary parasite of the typhoid fly, though its rôle may also be that of a primary parasite. A fact which contributed to our belief of its secondary rôle is the general likeness which it exhibits to Spalangia, a not uncommon thing between host and parasite or host and inquiline, though by no means the rule. But we have no evidence whatever to show that this is the case and are forced to the conclusion that the type species of the genus is a primary parasite in every sense.

In this third paper of this series, the genus is described and considered in detail and such biological facts as we were able to observe concerning it are also given. This genus, Spalangia and *Pachycrepoideus dubius* Ashm., already considered, are the principal primary parasites of the house fly, the species of Spalangia being the most numerous and common of the three genera. They will be considered in a paper to follow.

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[1] Continued from Vol. XVII., p. 117.

FAMILY PTEROMALIDAE.

SUBFAMILY PTEROMALINAE.

TRIBE EUTELINI.

Muscidifurax gen. nov.

Type: *M. raptor* sp. nov.

Female. Normal in stature and aspect for the tribe. The general aspect of *Tritneptis* Girault, 1908, and of *Cœlopisthia suborbicularis* Prov. (Ashm.); moderate in size, the head rounded and prominent; submetallic, black.

Head (cephalic aspect) subcircular, moderate in size, the line of the vertex, however, somewhat flattened, slightly bi-lobed, the facial (mesal) impression containing the scapes distinct, moderately deep, but gentle, moderately defined and narrow, its lateral margins obtuse, the scrobes subobsolete dorsad, distinct near the bulbs, the latter separated; face broad, the clypeus sub-hemispherical, its surface not impressed below the face, but with close, fine, longitudinal, converging striæ, its sutures obsolete, its apical (ventral) margin truncate but laterad, on each side of the comparatively broad entire mesal portion of the margin near the lateral termination of the sclerite is a small subacute notch or incision; (lateral aspect) head distinctly bulged or convex below (ventrad) its middle, forming in the cephalic aspect, a rounded, convex facial prominence just ventrad of the insertion of the antennæ; head widest just ventrad of the ventral ends of the eyes and then ventrad of the insertion of the antennæ obliquely truncate (cephalo-caudad), the line of the face sloping gently from the vertex to the antennal insertions and then abruptly, obtusely changing angle and nearly truncately cut off; obovate; eyes elliptical-ovate, about a fourth longer than the genæ, practically naked, but bearing sparse, very minute, erect hairs; head with no acute margins; genal sulcus obsolete. (Dorsal aspect) head somewhat wider than the greatest width of the thorax, about three times wider than long at the vertex, the latter slightly narrowed at the meson, but rounded and slightly convex at its apex at the ocelli, the occipital margin concave, narrowly rounded; the cephalic margin of the vertex obscure, subacute; the cephalic ocelli circular, larger than the ovate lateral ones, all in a flat or obtuse triangle in the center of the vertex, distant from the eyes, the lateral ocelli about twice the distance from the eye margins on each side as they are from the cephalic ocellus, and a little less than that distance from each other than each is from the cephalic ocellus, the group near the obscure cephalic margin of the vertex; visible margin of the eyes convex, entire; eyes widely separated. Antennæ inserted about two-thirds of the way down to the clypeus, below the middle of the face and about on an imaginary line drawn between the ventral ends of the eyes, or slightly ventrad of it, the scapes long and slender,

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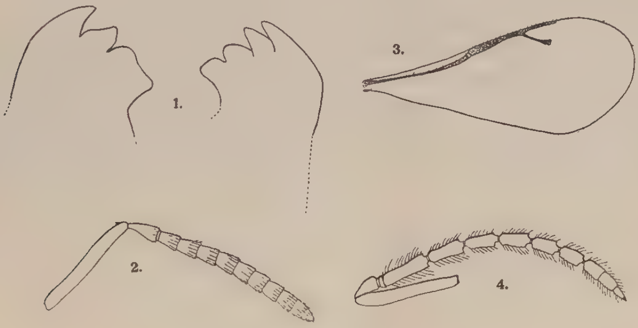
[1] *Muscidae* and *furax*, inclined to steal.

diverging and dorsad extending to the apex of the vertex, the flagellum long and cylindrical, slightly thickening distad; antennæ 13-jointed—scape, pedicel, 1 ring-joint, 7-jointed funicle and 3-jointed club; pedicel longer than the first funicle joint, the first and second joints of the funicle longest, the first joint the shorter of the two (Fig. 2). Mandibles 3- (left) and 4-dentate (right) (Fig. 1).

Pronotum distinct, narrow, transverse mesially, widening laterad, the lateral wings being cuneate, mesially not longer than a fourth of the length of the mesoscutum; thorax flatly convex; parapsidal furrows distinct, incomplete, inconspicuous, extending about one-half the length of the scutum, from the cephalic margin; axillæ widely separated; mesoscutum elliptical in outline, both the cephalic and caudal margin being broadly convex, the caudal margin nearly straight between the axillæ and impressed; scutellum with no transverse grooved line cephalad of the apex, but in its disk a few obscure, large punctures similar to those on the heads of many encyrtine genera, its apex broadly convex; mesopostscutellum narrow, following the outlines of the scutellum, its cephalic and caudal margins ridged or carinate; metathoracic spiracle moderately large, elliptical-oval, oblique in position and nearly its own length from either the mesopostscutellum or the lateral carina; median and lateral carinæ of the metathorax complete; median carina of the metathorax divided before base, each division proceeding latero-caudad to meet the lateral carinæ; the latter broken at caudal third; spiracular sulcus short, obscure. The whole of the head and thorax densely reticulated, amounting to punctation, the metathorax more coarse, punctate and rugose; abdomen finely, delicately reticulated, polished, the coxæ finely reticulated, nearly smooth.



Muscidifurax raptor sp. nov.

Fig. 1. Mandibles. Fig. 2. Antenna of female. Fig. 3. Fore wing of female (ciliation omitted). Fig. 4. Antenna of male. All enlarged; pubescence indicated only, not exact. Original.

Abdomen sessile, (lateral aspect) conic-ovate, concave dorsad longitudinally, convex or ridged along the meson ventrad and pointed caudad, with the tip of the ovipositor exposed, not compressed, subdepressed, as long as the head and thorax combined; (dorsal aspect) abdomen ovate, ending in a sharp point, widest at about the apex of the third segment, the second segment longest, occupying a fourth of the surface, segment 3 next longest, excepting 7 and 8, a third shorter, segments 4 and 5 subequal, slightly shorter than segment 3; the sutures between segments 2 and 3 obscure; segment 6 subequal to 3 but distinctly narrower, segment 7 triangular with the apex of the triangle caudad, at the meson three-fourths the length of segment 2; segment 8 pointed conical, as long as segment 6, the point of the ovipositor protruding from it slightly; segments 7 and 8 pubescent. Abdomen somewhat variable in shape, sometimes slightly triangularly produced ventrad at base.

Legs normal, the anterior and posterior femora with their caudal margins convexed in the middle, but not conspicuously or abnormally so, the tibial spurs all single, the cephalic ones largest, curved, notched at the apex; caudal tibial spurs not half as long as the slender proximal tarsal joint, which is longest, the fourth caudal tarsal joint as usual, shortest, the third nearly as short as the fourth, the second about half as long as the first and longer than the fifth. Caudal coxæ largest, their lateral aspect flat, the intermediate coxæ by far smallest. The cephalic coxæ subconical.

Fore wings normal, widest at a point opposite the stigmal knob, usually ciliate in the disk, the apex rounded; submarginal vein slender, its whole length gently concavely curved, slightly enlarging as it nears the marginal vein, about a third longer than the latter; marginal vein broadened, clavate, its base twice the width of the postmarginal vein, gradually narrowing distad, dark, nearly twice the length of the postmarginal and stigmal veins; the latter two veins, slender, short, subequal in length, the postmarginal vein slightly longer, the angle between them about 45°; the stigmal vein straight, bearing a small ovate knob with an uncus proceeding from its cephalo-distal margin near apex. Marginal cilia absent, excepting along the venation and distad along the caudal margin where they disappear as the apex of the wing is neared; short. (Fig. 3). Posterior wings widest before their middle; the cephalic margin of the wing is nearly straight, obliquing distad; the caudal margin broadly convex, broadly emarginate towards base, sloping distad but the apex obtuse; discal cilia dense, but delicate and minute; marginal cilia moderate in length on the caudal margin. Venation usual; about 22 hooklets. Maxillary palpi 4-jointed, the last joint much the longest, cylindrical oval. Labial palpi 3-jointed.

Male—The same. Eyes smaller, about the length of the genæ, ovate; antennæ more slender, filiform, more noticeably hairy, pilose, more loosely jointed, the distal funicle joints subpedunculate; 14-jointed, with two ring-joints and a 4-jointed club; the funicle but 6-jointed, the first funicle joint very long, cylindrical, narrowed in the middle, the joints shortening distad, the pedicel much shorter than the first funicle joint; apical joint spur-like (Fig. 4). Abdomen depressed, ovate, sessile, not as long as the thorax, the genitalia exserted in death; mandibles and other characters as in the female.

A genus closely allied to *Eutelus* Walker and *Platymesopus* Westwood, from both of which it is separated by the single ring-joint of the female antennæ, as well as more general characters.

Host Relations of the Genus.

The type and sole species of this genus, as our records given beyond will show, is an important primary parasite of the common house fly, of solitary habit and external, attacking the host in the puparium stage but not penetrating the body of the inclosed pupa, its larva obtaining nourishment through the body-wall of its host by means of absorption. Its host relations are therefore very similar to those of Spalangia — those species attacking Musca — in that it is mostly confined to a single host and is external and solitary in habit. But seemingly unlike the species of Spalangia, which we consider in another paper, this parasite also occasionally attacks other host genera, we having reared it rarely from the puparia of both the screw-worm fly, *Chrysomyia macellaria* (Fabr.) and also *Phormia regina* (Meig.); from the latter in the laboratory as well as in nature. Rarely, it was also reared from the larva of both of these flies.

Distribution of the Genus.

We have found this genus in what is practically a single locality in Illinois; in the two adjoining towns of Champaign and Urbana. In that locality it is common. Other portions of the state have not, of course, been explored in reference to it and we have no knowledge concerning its distribution in the United States.

The Type Species of the Genus.

Muscidifurax raptor sp. nov.

Female. Length variable; maximum length, 2.60 mm.; minimum length, 1.80 mm.; average length, 2.24 mm.; range, 0.80 mm.; mode, 2.30 mm.

General color black, with slight ænescence, subcorvinus; flagellum deep black, appearing slightly greyish from the pubescence; the abdomen with some brownish, at base ventrad on segment 3, a yellowish-brown spot on each side of the meson, often contiguous forming a transverse yellowish-brown band, and with traces of yellowish-brown dorsad at base of the second abdominal segment; the legs, excepting the concolorous black coxæ, and the scape fuscous, the femora dorsad and laterad variable, usually with blackish, especially in the caudal and cephalic femora; scape darker dorsad, pedicel and ring-joints with some yellowish; exposed portions of the mandibles black or dark fuscous; palpi dusky; tegulæ black; tarsi slightly paler, their distal joint black; wings subhyaline, the marginal vein conspicuous, black, especially proximad, the remaining venation dusky with some yellowish. Eyes dark garnet, with several discal black spots; ocelli pinkish, inconspicuous. Ventum concolorous, except as noted in the abdomen.

Pubescence of body moderately close, inconspicuous. Abdomen polished.

Flagellum moderately densely pubescent, the hairs short and closely applied; scape cylindrical, narrowing somewhat distad, equal in length, nearly, to the pedicel, ring-joint and 3 proximal funicle joints combined; pedicel long-obconic, its proximal end slightly curved, nearly thrice wider at its apex than at its base, not quite a third of the length of the scape and at least a fourth longer than the first funicle joint and its apex wider than that joint; ring-joint transverse, not as wide as the pedicel and about a fifth the length of the first funicle joint; first and second funicle joints subequal in length, both widening somewhat distad, the second somewhat wider than the first, each nearly a third longer than any of the next five funicle joints which are subequal in length, each, however, very slightly shorter than the one immediately preceding; the proximal club joint subequal in length and width to the seventh or distal funicle joint, the intermediate joint small, the apical joint small, obtusely conical, half the size of the preceding. Funicle joints 2–7 subquadrate. Club as a whole ovate, not much, if any, wider than the funicle, not equal to the united lengths of the three distal funicle joints (joints 5, 6 and 7 of funicle).

(From 194 specimens.)

Male. Length variable; 1.3–2.2 mm.; average, 1.82 mm.

The same as the female, differing in the usual secondary sexual characters pointed out in the generic description, and in color as follows: The base of the abdomen in the dorsal aspect has a large conspicuous, rounded, honey-yellow spot, distinct to the naked eye, which is but slightly indicated in the female by the presence of some yellowish-brown in that region; in the same region ventrad, the area is larger than that in the female and rounded. The antennæ have an additional ring-joint, one joint less in the funicle and a very minute, additional fourth club joint, which are the unusual secondary structural features.

Flagellum filiform, pilose. Scape slender, a fourth longer than the pedicel, ring-joints and first funicle joint united; pedicel obconic, not as long as in the female, not by far a half the length of the proximal funicle joint, subequal in length to the distal (6th) funicle joint; ring-joints transverse, the second nearly twice the size of the first and darker in color; funicle joints all longer than wide, abruptly shortening distad; first funicle joint by far the longest, cylindrical, narrowed or constricted obtusely at the middle, over half the length of the scape, subequal to the club in length, somewhat shorter, with an indication of a petiole or peduncle at its apex and a third longer than the second funicle joint; the latter slightly constricted at proximal third, with a more distinct petiole, the third and fourth funicle joints subequal, each a fourth shorter than the second funicle joint; funicle joints 5 and 6 subequal, each a fourth shorter than either the third or fourth funicle joints, and each about half the length of the proximal funicle joint. Petiole or peduncle of joints 3, 4, 5, and 6 of the funicle distinct but not long; funicle joints 5 and 6 acute at their disto-lateral angles, the others less distinctly so; club moderately long, tapering to a point, distinctly shorter than the scape, its proximal joint somewhat shorter than the sixth funicle joint, but nearly as wide, its second joint slightly longer and as wide, its third joint conical, with a narrow truncate apex, not quite as long as the proximal joint, and the fourth distal joint minute, nipple-like, resembling a small conical spur and terminating in a seta.

(From 80 specimens.)

Types: Accession No. *40,250,* Illinois State Laboratory of Natural History, Urbana, Illinois, 32 ♂'s, 81 ♀'s, tagmounted.

Cotypes—Cotype No. *12,240,* United States National Museum, Washington, D. C., *2* ♂'s, *2* ♀'s, tagmounted.

Viewed with a hand-lens, the female is uniformly glossy black with a conic-ovate, smoother abdomen which projects to the tip of the wings, marked ventrad near base with brownish-yellow, the wings hyaline with brownish-black marginal, postmarginal and stigmal veins, the latter distinctly tapering from the thicker base to apex; the legs, excepting black shining coxæ, brownish-yellow marked indistinctly with darker, the lateral aspect of the posterior femora dark; the antennæ black with the scape dark brownish. Eyes and ocelli dark garnet, the former with a discal blackish spot, not distinct; the pubescence indistinct on antennæ and body, giving the former an indistinct greyish appearance in direct light. The sculpture of head and thorax appears distinctly as a very slight, uniform and delicate roughening. The antennal flagella are about as long as the thorax. The sculpture appears rougher along the surface of the metanotum.

The male appears the same as the female, excepting the shorter, flattened, depressed abdomen containing a moderately large, brownish-yellow spot in the middle near base, and the slenderer, loosely-jointed, softly hairy antennal flagella, the pilose pubescence of which is distinct and yellowish grey.

When viewed with the naked eye, the parasites look like black gnats with long bodies, indistinct brown-yellow legs and indistinct clear wings which are folded along the back in the usual position for the Pteromalidæ. They appear a third smaller in size than *Pteromalus puparum* (Linn.) for instance to the naked eye and the sexes cannot be certainly separated without enlargement. Through a lens, however, the antennal and abdominal characters previously mentioned, together with the exserted genitalia of the male, allow them to be distinguished with readiness. To some extent, to the naked eye, the species resembles some of the smaller species of Spalangia and more closely, *Pachycrepoideus dubius* Ashmead, but the bodies of the latter are noticeably shorter and more compact, the antennæ shorter and stouter.

Described from the following 324 specimens, all, with the exception of 50, now in the collection of the Illinois State Laboratory of Natural History and all reared from various house fly puparia, and those of two other Diptera, during the investigations of 1908 in the insectary of the office of the State Entomologist of Illinois at Urbana. Unless otherwise stated all of the specimens are mounted on tags.

(1) Eleven males of the parasite emerged singly on October 17, from 11 puparia of *Musca domestica* Linnæus which had been exposed in the insectary September 20 and 30; accession No. *40,231* 11 ♂'s. (2) On October 24 from the same lot of isolated puparia, there were removed 34 ♂'s, 83 ♀'s; accession No. *40,250,* 32 ♂'s, 81 ♀'s (2 ♂'s, 2 ♀'s — *Cotype No. 12,240,* U. S. N. M.). (3) 6 ♀'s from the same lot April 25, 1909; accession No. *41,082,* 6 ♀'s. (4) 2 ♂'s, 2 ♀'s, part of 7 ♂'s, 3 ♀'s reared October 2 from *Musca* puparia (see 11), parents of the next two numbers; accession Nos. *40,248,* 1 ♂, 1 ♀, and *40,246,* 1 ♂, 1 ♀. (5) 4 ♂'s, 19 ♀'s reared October 20 and November 7 from single *Musca* puparia in confinement, progeny of the single pair of accession No. *40,248* (see preceding); accession Nos. *40,249,* 3 ♂'s, 10 ♀'s and *40,269,* 1 ♂, 9 ♀'s (6) 1 ♂, 14 ♀'s reared October 20 to November 7 from 15 *Musca* puparia in confinement, progeny of the single pair of accession No. *40,246* (see 4); accession Nos. *40,247,* 1 ♂, 7 ♀'s and *40,268,* 7 ♀'s. (7) 3 ♂'s reared September 26 from three *Musca domestica* puparia formed from maggots in horse manure and exposed to parasitism in the insectary September 8 to 11; accession No. *40,144,* 3 ♂'s. (8) 4 ♂'s reared from four of the same host lot, September 27; accession No. *40,146,* 4 ♂'s. (9) 2 ♂'s reared from two of the same host lot September 28; accession No. 40,150, 2 ♂'s. (10) 2 ♂'s, 7 ♀'s reared from nine of the same host lot September 30; accession No. *40,153,* 2 ♂'s, 7 ♀'s. (11) 2 parthenogenetic females, reared from two puparia of lot 4 in preceding, parents of the following; accession Nos. *40,298* and *41,000,* 2 ♀'s. (12) 2 ♂'s reared October 24 from two puparia of *Phormia regina* (Meigen), parthenogenetic

progeny of the preceding number; accession Nos. *40,299* and *41,001*, 2 ♂'s. (13) 5 ♂'s, 9 ♀'s reared as in lot 4; discarded. (14) 3 ♂'s, 12 ♀'s+42 reared October 4 with several *Spalangia* and 1 ♂ *Pachycrepoideus dubius*, from 57 *Musca domestica* puparia, exposed to infestation September 8–11; accession No. *40,171*, 3 ♂'s, 12 ♀'s. (15) 22 ♀'s+8 reared from 30 of the same lot as 14, the same species present in larger numbers, October 11; accession, No. *40,205*, 22 ♀'s. (16) 1 ♀ collected in insectary around fly-breeding cages, September 10, parent of the next number; accession No. *39,965*, 1 ♀. (17) 7 ♀'s reared in confinement from 7 puparia of *Musca domestica* October 1, progeny of the single female of the preceding; accession No. *40,169*, 5 ♀'s. (18)♂, 1 ♂, each removed October 13 from single puparia of *Phormia regina* (Meigen) obtained from garbage at the city dumping-grounds, Champaign, September 23; accession No. *40,217*, 1 ♂, 1 ♀. (19) 1 ♀ reared from a *larva* of *Phormia regina*, collected in garbage at the city dumping-grounds, Champaign, October 21, and removed from the capsule containing the host larva on November 6; accession No. *40,258*, 1 ♀. (20) 2 ♂'s, 2 ♀'s reared from four *Musca domestica* puparia September 29, parents of the next number; accession No. *40,242*, 2 ♂'s, 2 ♀'s. (21) 2 ♀'s reared in confinement from two puparia of *Phormia regina* (Meigen), October 19, progeny of the preceding; accession No. *40,243*, 2 ♀'s. (22) 3 ♂'s, 3 ♀'s reared from six *Musca domestica* puparia, September 30, parents of the next; accession No. *40,244*, 3 ♂'s, 3 ♀'s. (23) 1 ♂, 1 ♀ reared in confinement from two puparia of *Phormia regina* (Meigen), October 19, progeny of the preceding; accession No. *40,245*, 1 ♂, 1 ♀.

BIOLOGICAL NOTES.

The brief duration of the investigations and the lack of time and opportunity prevented an extensive study of the life-history and biology of this parasite, and because of its lesser abundance and the somewhat greater difficulty experienced in handling it in confinement, not as much was learned concerning it as in the case of *Nasonia brevicornis* Ashm. It is more sensitive than the latter, has an apparently limited number of hosts and is solitary; yet, notwithstanding these, with time and opportunity, its biological history could be learned with ease in the laboratory, as the females are not at all adverse to ovipositing in confinement, as in the case of Spalangia and many other Chalcidoidea. But seemingly it is not as prolific and as general a parasite as is Nasonia.

We have not obtained positive data concerning the entire seasonal history of this parasite, but our observations indicate that it confines itself principally to the puparium stage of the house fly, following this single host throughout and hibernating in the host puparium as a larva, pupating and emerging early in the spring in time to attack the first host generation. The investigations concerning the house fly, and during which this parasite was discovered, did not commence until late in July, and the parasite did not appear, so far as we know, until the first week in September. From then on, until freezing weather commenced, it was comparatively common. It was reared from host puparia collected on September 23; and again, nearly a month later, from hosts collected on October 21, from a garbage heap then literally swarming with muscid maggots (Musca, Chrysomyia, Phormia); and from this last lot of puparia a few adults of the parasite had emerged by November 6. On October 21 hibernation had probably commenced, for although adult Spalangia were found to be rather numerous in the soil around the muscid puparia at the garbage heap, neither *raptor* nor *Nasonia brevicornis* were seen. Further, hosts collected on November 14, 1908, from the same garbage heap, then covered with snow, when confined in the warm insectary, produced both adult *raptor* and *Nasonia brevicornis* which emerged about a month later, their development having evidently been hastened by the warmth. Facts such as these, strongly indicate hibernation in the host puparia and analogy would lead to the belief that this species has a winter history somewhat similar to that found in *Nasonia brevicornis.*

As briefly as possible, we summarize the few special experiments conducted with this parasite in the laboratory.

I. An adult female captured in the insectary around fly-breeding cages, September 13, was at once confined in a vial with a single puparium of *Phormia regina;* oviposition was observed within the next 24 hours, after which the parasite was released. No emergences followed. However, the host was examined in March, 1909, and found to contain fragments of the host pupa, the dead larva of this parasite, its body blackened but still soft up to May 20 following and its peculiar meconium. Hence, this parasite attacks *Phormia regina* in confinement.

II. *a.* On October 1, a pair of adults just reared from Musca puparia in horse manure were confined with 40 healthy puparia of the same host reared in confinement from maggots in garbage. Oviposition occurred and on October 20 following, four males and 19 females emerged as the offspring of the single female, making a total progeny of 23.

b. Another pair from the same source and emerging at the same time were similarly confined with 30 fresh Musca puparia reared from the maggots in garbage. Reproduction occurred and on October 20, one male and 14 female parasites emerged as the total progeny of this pair.

Hence in confinement, single females were able to kill 23 and 15 hosts respectively, necessarily laying eggs to the extent of those amounts.

III. A single female parasite captured around the fly cages in the insectary, September 10, was confined in a glass vial with 11 healthy puparia of *Musca domestica* reared from maggots in horse manure; the parasite was confined with the hosts at 11.50 a. m. the day of capture. As a result, on October 1, seven adult females had emerged, the total progeny; two of the remaining hosts died but examination disclosed no symptoms of parasitism; the other two produced 1 ♂ and 1 ♀ of the host on September 14.

IV. Eleven females reared from 11 puparia of *Musca domestica* in horse manure September 29–30, and isolated at emergence — hence virgin — were separately confined during September 30 with single puparia of *Phormia regina.* Reproduction occurred and in three cases single males resulted as the progeny of three of the virgin parents; adult hosts emerged in three cases and the remaining hosts died without showing symptoms of parasitism. Hence parthenogenesis occurs with this parasite, the unfertilized ova producing males. Here, there can be no doubt but that the females were unfertilized, mating within the puparium, obviously, being impossible.

V. *a.* September 29, two males and two females of the parasite reared from four puparia of *Musca domestica* on the same day, earlier in the morning, were confined with 15 puparia of *Phormia regina.* Oviposition was observed at 11.45 a. m., and doubtless occurred again. The resultant progeny proved to be two females from two of the puparia, emerging on the 19th of October.

b. Experiment similar to *a.* The following day three pairs of the parasite from the same source as in preceding were confined with 17 of the same host puparia, the resulting progeny proving to be one male and one female, emerging on October 19 following.

The experiments indicate fecundity, give the approximate duration of the life cycle and establish parthenogenesis, which, however, remains to be verified. They also show the readiness with which the puparia of Phormia are attacked in confinement.

HABITS AND BIOLOGY IN GENERAL.

As the observations on all points of the life history and biology of this parasite were necessarily desultory, they can be presented in no other way than one seemingly fragmentary. For convenience and brevity they are summarized or collected under the following headings.

A. *Nature of Parasitism.* In the 309 (77 ♂'s, 181 ♀'s, 51 undetermined sex) cases of parasitism which were isolated in small gelatine capsules with special reference to the nature of parasitism, of which all but nine of the hosts (4 ♂'s, 5 ♀'s of the parasites) were *Musca domestica,* every one yielded but a single parasite, which shows beyond doubt that the species is solitary in habit, even when — rarely — attacking comparatively large hosts such as Chrysomyia and Phormia are. In a critical examination of the hosts, after the emergence of the parasite, it was found that in nearly all cases they were considerably reduced in bulk, but not noticeably in length, recognizable as pupæ, flattened, along the abdomen especially, hardened, shrunken and blackened — not collapsed or eaten away — indicating that the larval parasite was attached to the external body-wall of the host, obtaining its nourishment by absorption through it. This indication has been proven to be a fact by several direct observations made on dissected hosts, known to be parasitized by this species, and the further fact established, namely, that the larval parasite has no particular choice as regards the portion of the body of the host to which it attaches itself or rather to which it becomes attached. The destruction of the host is more complete than with Nasonia, for some host pupæ are mere hollowed-out shells of the venter, but less so than is the case with Spalangia. In a few instances the hosts were mere fragments, but the great majority were as has been described.

After emergence of the adult parasite, an examination of the host puparium reveals at first the shrunken and blackened remains of the host pupa lying in its natural position along the floor of the puparium and attached to it, usually along the dorsum of the caudal portions of the abdomen, the yellowish pupal cast of the parasite and then caudad of the host remains, lying upon the floor of the puparium, free, the peculiar, round-angled, dark meconium of the parasite larva; or the latter may be attached to the host remains as in Spalangia, there resembling a dark clot. As this meconium is characteristic, and can be readily distinguished from that of Spalangia, and hence forms an available means of identity when others are absent, by way of description it may be stated that, to the naked eye, it resembles a small solid, black-brown bead, about thrice the size of a visible grain of sand, resembling somewhat a coarse grain of powder, but not as irregular or as angular, measuring actually about .8 mm., its general outline convex and dome-shaped, the bottom flat, and the convex upper side, with a concavity, groove or impression along or in its center or at one end; this impression is quite often segmented, and as it is known that it is formed by the abdomen of the parasitic pupa which rests in it, the segmented appearance is due to the impression made in the then soft meconium by the incisions of the abdominal segments of the larva; the place of this groove is variable, and it may be absent, tending to show that the pupa of the parasite was not attached to it in the usual way; the edges of the impression are quite often acute or sharpened ridges; from above the meconium's outline is circular, with some irregular angulation: rarely it is quite irregular. It is much smaller in diameter — at least by a half — than the meconium of Spalangia which is wider and flatter, lozenge- or discus-shaped, and hence the two are readily distinguished on comparison. So far as the evidence goes, the manner or nature of the parasitism does not differ for sex of the parasite nor for species of the host. However, in four authentic instances, instead of the puparium stadium being affected, it was the larval stadium. The hosts in these instances were *Chrysomyia macellaria* and *Phormia regina* and the parasites emerged from single, nearly full-grown larvæ isolated in capsules.

B. *Emergence of the Adult.* When perfect and mature, having cast the pupal integument and rested, the adult parasite in order to obtain its freedom cuts a single rounded hole, measuring from 0.60 to 1.25 mm. diameter, through the puparium with its mandibles. This exit-hole varies in position but is usually cephalad or caudad and in the dorsal aspect. Its edges are ragged or serrated. It does not vary for sex or host and is not unusual. In rare cases the parasite may make as many as four exit-holes, obviously because of its failure to accomplish its exit readily, as is normal. So far we know of no characteristics distinguishing the exit-holes of this parasite from those of Spalangia or Pachycrepoideus.

In regard to the time of emergence. The two sexes appear almost simultaneously, but our rearing records indicate an earlier appearance of the male as is usual. This sex, in a cycle lot of the same age, may appear from 24 to 36 hours earlier than the females, but not all together, the time given referring to the individuals of earliest appearance. The tendency in development is for a more rapid maturity of the males, taking the sex as a whole.

C. *Oviposition; Number of Eggs Deposited.* The facts concerning this habit are not well known and our observations are briefly stated. In one of the two cases observed, the host being *Musca domestica* Linnæus, the position of the female was essentially the same as with *Nasonia brevicornis* Ashm.; the ovipositor was inserted into one end of the host dorsad and 90 seconds were occupied in inserting or boring the ovipositor into the host, and the ovipositor was fully inserted for 105 seconds. In the other case observed (September 9, 1908), the female stood lengthwise along the *domestica* puparium, along the median line dorsad, and inserted the ovipositor between two caudal segments; the antennæ and abdomen were moved slightly during the operation which lasted for seven minutes (6.15 a. m.); subsequently during the same day, this same female was observed making (apparent) oviposition into the same host, so that, though solitary, several ovipositions into single hosts may occur (confinement). As already stated, occasionally (rarely) the female may deposit into maggots, apparently when young, but it is a question how this occurs or under what conditions it could be accomplished.

Regarding the number of eggs deposited. But two observations of worth were made concerning this, as recorded on a previous page (experiment II.). Here two pairs of adults were given access to a number of healthy hosts, allowing some range in choice as regards the number of progeny. In case *a,* 23 progeny out of a "possible" 40 resulted, and in case *b,* 15 progeny out of a "possible" 30 resulted. As these pairs were fresh and had not reproduced previously, the results at least give us some notion concerning fecundity of the species.

D. *Length of Life Cycle.* We know nothing concerning the duration of the different stages, and but little concerning the duration of the cycle as a whole. What has been learned, was obtained by experiments conducted in confinement and is summarized in the following table:

TABLE I. DURATION OF THE LIFE CYCLE IN *Muscidifurax raptor,* SEVERAL CYCLES, 1908.

Lot No.	Number of Progeny.	Eggs Deposited.	Adults Emerged.	Duration of the Cycle.	
				Days.	Hours.
1	5 ♀'s	Noon, Sept. 10	10 a. m., [1]Oct. 1	20	22
2	2 ♀'s	Noon, Sept. 29	Noon, [1]Oct. 19	20	0
3	2 (♂♀)	9 a. m., Sept. 30	3 p. m., Oct. 19	19	6
4	23 (4 ♂'s, 19 ♀'s)	Noon, Oct. 1	Noon, Oct. 20	19	0
5	15 (1 ♂, 14 ♀'s)	Noon, Oct. 1	4 p. m., [1]Oct. 20	19	4
Average..				19	17

E. *Proportion of the Sexes.* Of the 288 reared specimens of this species concerning which the nature of the sex was recorded, there were 85 males and 203 females, or nearly two and a half times more females than males. This high preponderance of the females is unexpected in view of the natural history of the species, but parthenogenesis may account for it, following as it does no general law in the Hymenoptera. The figures given are for the whole total of the specimens reared by us, either artificially or from hosts obtained in nature and the proportions may be warped. Of the former — those bred in confinement, hence artificially — totalling 52, but nine were males and the remaining 43 females, the preponderance being still greater; of the 236 specimens obtained from hosts collected in nature, 77 were males and 159 females; the preponderance is much less than in the other class, being but as two is to one, and we are inclined to believe it to be the true condition.

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[1] Approximated to hours.

THE FOOD OF CALLIGRAPHA BIGSBYANA, A CHRYSOMELID BEETLE.

By Robert W. Hegner,

Ann Arbor, Mich.

All of the adult specimens and larvæ of *Calligrapha bigsbyana* secured for me, or that I myself have collected, have been found upon the long-leafed willow, *Salix longifolia,* and so far as I have been able to ascertain, they do not occur in nature upon any other species of plant. It was discovered several years ago that both adults and larvæ thrive equally well in the laboratory when fed upon leaves of *Salix amygdaloides* (Hegner, 1908).[1] The following experiment was undertaken to learn if *Salix longifolia* is preferred.

Larvæ that had been fed in the laboratory on *Salix amygdaloides* pupated on July 2, and the adults emerged on July 14. On July 15 two males and two females were placed in a stender dish containing three leaves each of *Salix longifolia* and *S. amygdaloides.* The beetles crawled over the bottom, sides and top of the dish as well as over the leaves, and if they had preference for either sort of leaves they were given ample opportunity to show it. The leaves of *S. amygdaloides* were attacked as quickly as were those of *S. longifolia,* and as much of the former was eaten as of the latter. The experiment was continued for a month, fresh leaves of each species of willow being supplied to the beetles every day, but in no instance was a preference for either sort observed.

Beetles that are kept in stender dishes usually lay their eggs upon the leaves, but sometimes they fasten them to the sides or top of the dish. The two females used for this experiment chose one kind of leaf as often as the other upon which to lay their eggs. Why these beetles are found only on *S. longifolia* in nature, though they show no preference for it in the laboratory, is a question still unsolved.

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[1] Observations on the Breeding Habits of three Chrysomelid Beetles, Calligrapha bigsbyana, C. multipunctata, and C. lunata. Psyche, Vol. 15, pp. 21–24.

SOME EXPERIMENTS ON THE RESISTANCE OF GYPSY MOTH EGGS TO THE DIGESTIVE FLUIDS OF BIRDS.

By William Reiff.[1]

The subject of the present paper has already been referred to in a previous article published in one of the recent numbers of this journal. There I referred to the investigations of Alexander Bau who determined by numerous experiments that the eggs of certain species of Lepidoptera will pass out undigested, and still remain in a living state after a trip through the stomach and intestines of some species of birds. On this account I thought that Gypsy Moth eggs which have extremely hard chitinous shells, might readily withstand such a journey without damage. If this should prove true the sporadic diffusion of the Gypsy Moth in New England, which has hitherto been so mysterious, might find a partial explanation.

In selecting the birds used for these experiments it proved impossible to get native species and I was compelled to substitute foreign birds such as sparrows and finches. Altogether species belonging to the following four families were utilized:

Fringillidæ. (German Canary Bird, English Yellow Hammer and English Chaffinch.)
Turdidæ. (Japanese Robin.)
Bubonidæ. (Screech Owl.)
Columbidæ. (Carrier Pigeon.)

German Canary Bird.

One dispar egg cluster overwintered in outside temperature was divided into two parts early in March, 1910. One half was put apart for control while the other was separated into its individual eggs. The eggs were put into small crumbs of bread to which small pieces of cochineal were added for the purpose of tracing the eggs in the droppings of the bird. The food thus prepared was given to the bird early in the morning and had passed through the alimentary tract at the expiration of an hour and twenty minutes. All the red excrement was collected the same afternoon and dried in the air for two days. To facilitate the hatching of the caterpillars from such eggs as might be contained in the excrement, this was carefully broken into small pieces. Seven eggs were found but each had the shell slightly injured by the bird's beak. The rest of the eggs had not been eaten but had been picked out of the crumbs of bread by the bird and thrown aside. The hatching of caterpillars from the control eggs began on March 21 and was completed two days later, but the seven eggs obtained from the excrement failed to hatch, having dried up.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 24.

In the following experiments the same precautions were taken, keeping control eggs from each cluster used and adding bits of cochineal so that this need not be mentioned in the case of the other birds.

English Chaffinch

A bird of this species was fed in the same way but the eggs were not passed in the excrement until nearly three hours after feeding. The excrement was dried and broken up as before but not a single dispar egg could be found. These missing eggs were later found uneaten, having been cast aside by the bird.

English Yellow Hammer.

A specimen of this species was fed as before but the eggs were placed in living larvæ of the meal-beetle which had been cut open on the last four abdominal segments to insert the Gypsy Moth eggs. The bird was fed with these in the morning and after an hour and a half they were passed in the excrement of the bird. In this case twelve dispar eggs were found and no sort of injury could be detected on any of them. Other eggs fed in pieces of bread were cast aside by the bird and not eaten. Although the caterpillars from the control eggs hatched normally all those fed to the bird failed to hatch. These changed color normally but died with a nearly developed caterpillar in each egg.

Japanese Robin.

This bird was fed on eggs placed in meal-beetle larvæ as was done with the previous bird. The bird was fed late in the morning and an hour and a half later the eggs were passed in its red excrement. Fifty-two eggs were found in this excrement and of these one hatched on the 23rd of March, followed by two on the morning of the 24th. A later investigation showed fully developed caterpillars in the eggs which had failed to hatch.

Screech Owl.

I at first attempted to feed the owl on bits of chopped beef in which eggs had been placed but it refused to partake of this mixture. It was then allowed to fast for a couple of days after which I offered it a freshly killed mouse into which one hundred and twenty dispar eggs had been placed through an incision made in the abdomen. This prepared mouse was given to the bird late one afternoon and was eaten during the following night. Late the next afternoon I found the red colored vomitings composed of the indigestible parts of the mouse and these contained a considerable number of dispar eggs, although none could be detected in the excrement. Altogether I found one hundred and twelve eggs, every one without any sign of injury. At the same time that the control eggs began to hatch some of those obtained from the owl gave forth caterpillars until altogether seven appeared. All of the others failed to hatch although they changed color in a normal way.

Carrier Pigeon.

This bird was fed upon a mixture of boiled pigeon-food to which the Gypsy Moth eggs were added. This was given to the pigeon late in the morning and after three hours had passed through its alimentary tract. Quite a number of eggs had been eaten by the pigeon but none was found in the excrement.

To sum up the details of these various experiments it is seen that Gypsy Moth eggs can withstand the action of the digestive fluids of birds belonging to at least two families, Turdidæ and Bubonidæ, without suffering any, or only slight, injury. In regard to the large family, Fringillidæ, also an insectivorous group, I am inclined to believe that these birds might also occasionally distribute Gypsy Moth eggs in spite of the negative results obtained in my experiments. Since the members of the pigeon family grind up their food in a gizzard filled with small stones it is very unlikely that Gypsy

Moth eggs could pass through their intestines without being destroyed.

In conclusion I wish to express my hearty appreciation to Prof. W. M. Wheeler, Prof. W. E. Castle and Dr. A. L. Reagh for their advice and assistance.

GEOMETRID NOTES.

By L. W. Swett,

Boston, Mass.

A New Cingilia.

Cingilia rubiferaria, sp. nov.

Expands ♂ 32-33 mm., ♀ 24-25 mm. Fore wings slate colored and semi-hyaline much thinner in texture than in *C. catenaria,* due to the much fewer scales and further apart, also more hairy. In some specimens the color is smoky brown but not so prevailing as the slate color. Front of head bright ocher as are tufts on thorax, but body is gray. First markings start on costa one fourth out, notched on each vein and black same as *catenaria* but not so distinct while it is always plain in the latter. Discal spot black, beyond extra discal lines runs zig-zag notched on the veins as *catenaria.* Black dots at ends of veins in fringe which is dusky. Hind wings same color as fore, with single extra discal notched line and dots at ends of veins. Beneath same as above only the lines are just visible which is not true of *catenaria* where they are strong. The female is strikingly different from the male being about one half the size and presents rather the appearance of a moth whose wings never fully expanded. The body is extremely heavy for the size of the moth and it is doubtful if it can fly. The markings are the same as the male except from the extra discal line on fore and hind wings the veins are black to outer border. Beneath same markings as above the black veins running from extra discal lines on fore and hind wings to inner margin.

I was at first inclined to place this as a melanic race of *catenaria,* it not being found in any place outside of Attean Pond, Maine, so Mr. Lucas tells me, and he examined the vicinity, nor did he take any *catenaria* at the same place. The small size female and the more hairy and thinner scaled wings would serve to separate it from *catenaria* and also the hairs appear broader under the microscope giving the wings a transparent look. This species was taken by Mr. Lucas at Attean Pond in northern Maine near Moosehead

Lake and was fairly plentiful flying up from the low bushes which surrounded the pond, there being no trees, but the females were crawling around probably due to the heavy body of the female, and very rare.

♀ type, Attean Pond, Maine, October 3, 1909, in my collection.

♂ cotypes, Attean Pond, Maine, October 3, 1909, distributed in the following collections: Boston Society of Natural History, William Reiff, G. H. Field, F. X. Williams, A. J. Crocker, University Museum of Harvard College and ten in mine, also in Brooklyn Institute Coll. from Dr. Hulst, Maine. ♀ cotypes, G. H. Field, William Reiff, and five in mine.

Mr. Guy Lucas turned up this interesting species in Moosehead Lake region, northern Maine, and I recognized it as being new and was going to describe it as *"lucasi"* when I took a trip to Brooklyn, N. Y., and saw my *lucasi* labelled *rubiferaria* Hulst from Maine. I looked up the literature and found Doctor Hulst never described this so I propose to keep it under the original name to avoid future controversy.

A NOTE REGARDING THE LIFE HISTORY OF ASCODIPTERON.

In a recent letter from my friend, Mr. F. Muir, he announces the sending of a paper which embodies results of his studies regarding the life history of Ascodipteron; and as it may be some months before his report can be published, it seems wise to offer this short preliminary notice. Mr. Frederick Muir, while engaged in collecting insect parasites in the Dutch East Indies, has made the following observations regarding the life cycle of Ascodipteron:

By the wings and the entire structure of the male, it proves to be very closely allied to the Streblidæ. The female is at first fully winged, but imbeds herself in the bat hosts, cuts off her wings and legs, and undergoes a post-imaginal metamorphosis which converts her into the flask-shaped grub originally described by Doctor Adensamer. This is brought about by the abdomen growing to an enormous extent, and completely covering the head and thorax. The proboscis of the female is greatly altered to enable her to penetrate the skin of the host, but its homology to the proboscis of the normal fly is perfectly clear. A more complete and detailed description of this bizarre type will follow in a later number.

Thomas Barbour.

WESTERN LEPIDOPTERA. III.

NOTES ON LEPTARCTIA CALIFORNIAE WALKER.

By KARL R. COOLIDGE,

Palo Alto, California.

Some time ago while looking over the lepidopterological collection of Mr. J. G. Grundel, of Alma, Cal., I was struck by the great range of variation exhibited by *Leptarctia californiæ,* a rather common Arctian in the vicinity of San Francisco Bay. In one series of thirty-eight specimens, all from the same lot of eggs, hardly any two were at all alike, and no two exactly so, although *californiæ* is quite a plainly fashioned insect. The history of *Leptarctia californiæ* well illustrates the numerous troubles caused by a species much given to variation. The genus *Leptarctia* was established by Stretch, in his Zygænidæ and Bombycidæ of North America (p. 119), with *lena* Boisd. (=*adnata* Boisd.) and *decia* Boisd., both of which had been described in the genus *Lithosia,*[1] and a new species, which he called *dimidiata.* These forms he tabulated as follows:

Lower wings red	*L. decia*
Lower wings yellow	*L. lena*
Lower wings black	*L. dimidiata*

These three species we find depicted on plate 5, nine figures of *lena,* three of *decia,* and four of *dimidiata* being given. Stretch was evidently aware of the great amount of variation displayed in *Leptarctia,* as he remarks on page 121, under *L. lena,* "The wonderful variations of this species, show how necessary it is to have a long series of many insects before it is possible to determine the limits of the species. It is possible to select three or four types of the insect under consideration, so unlike each other, that in the absence of intermediate intergradations they might readily be considered specifically distinct; it was indeed a long time before I could satisfy myself of their identity, especially as the shape of the primaries is by no means constant, but the past summer has supplied so many intermediate links that there can be no longer any reasonable doubt." In 1855, however, Walker had described in the British Museum

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[1] Five species of *Cithene* were also placed in the same genus by Boisduval. Subsequently he remarks that the three former (*lena, adnata and decia*) "should perhaps be placed in a new genus near Nemeophila."

Catalogue Lepidoptera Heterochroa, *Nemophila californiæ,* which, as Stretch showed in his addenda and corrigenda (p. 240), is the same as *lena* Boisd., of which *adnata* Boisd. was a synonym, and as it has priority, *lena* must itself drop into synomical rank. Packard, Synopsis of the Bombycidæ of the United States, 1864, does not record any of the forms of *Leptarctia.* Stretch, under *L. lena,* wrote, "I strongly suspect that *Pltaarctia modesta,* Packard, is one of the many varieties of this species, although a specimen forwarded to Doctor Packard was returned with this query, 'What is it?' That it is congeneric is, I think, beyond doubt, as the peculiar thoracic markings are minutely given in the diagnosis of *P. modesta.*" *Pltaarctia modesta* has, however, turned out to be only a form of *Parasemia plantaginis* Linn., another very confusing and variable species. In 1882 Grote (New Check List of North American Moths) gives *decia, lena* and *dimidiata* specific rank, with *californiæ* as a synonym of *lena.* This arrangement concurs with that of the list of the Brooklyn Entomological Society (1881), except that there is no mention of *californiæ* in the Brooklyn list. In 1881 Butler (Ann. Mag. Nat. Hist., Vol. VIII.) describes four more varieties, namely: *Stretchii, Boisduvalii, latifasciata* and *fulvofasciata,* his descriptions being based on the specimens figured by Stretch. He also retains as valid, the four names already proposed. In 1889 Prof. G. H. French published in the Canadian Entomologist, Vol. XXI., a paper on the "Preparatory Stages of Leptarctia californiæ Walker, with Notes on the Genus." In this paper all of these eight names are retained and in addition three new varieties are described. His arrangement may be summarized as follows:

Leptarctia californiae Walker.

Var. 1, *stretchii* Butler.
Var. 2, *boisduvalii* Butler.
Var. 3, *dimidiata* Stretch.
Var. 4, *albifascia* French.
Var. 5, *occidentalis* French.
Var. 6, *latifascia* Butler.
Var. 7, *fulvofascia* Butler.
Var. 8, *californiæ* Walker (Typical).
Var. 9, *wrightii* French.
Var. 10, *decia* Boisd.
Var. 11, *lena* Boisd.

Wood engravings are given of all these, together with a brief description of each form. Later writers have considerably cut down this list. Dyar (Cat. N. Amer. Lepid., 1902) lists but three forms as valid, these being *californiæ* Walker, *decia* Boisd. and *dimidiata* Stretch, the last two being placed as varieties. Holland, in his Moth Book (p. 121, 1903) places *lena, decia* and *dimidiata* as forms of *californiæ*. Thus, according to Dyar's list, we find again the three forms originally listed by Stretch, viz.: *californiæ* Walker (*lena* Boisd.), *decia* Boisd. and *dimidiata* Stretch.

The principal variation in the coloration of *Leptarctia californiæ* is in the secondaries, and the amount of black on the same wings is also very variable, from a few black points to uniformity. The variation even extends to the shape of the wings, the primaries being by no means constant. But it is the color variations that have brought *L. californiæ* to grief. The numerous varieties described were but individual variations of a single species as I can find all of the forms now recognized, with all intergradations, and in addition some which would certainly be worthy of being described as new if we were to go by some former standards, in this series of thirty-eight specimens, all from the same female. There is no doubt that we have but a single species of the genus *Leptarctia,* and the synonomy must stand as follows:

Leptarctia californiae Walker.

L. lena Boisd. 1868–'69.
L. adnata Boisd. 1868–'69.
L. dimidiata Stretch. 1872.
L. stretchii Butler. 1881.
L. boisduvalii Butler. 1881.
L. latifascia Butler. 1881.
L. fulvofascia Butler. 1881.
L. albifascia French. 1889.
L. occidentalis French. 1889.
L. wrightii French. 1889.

Stretch's remarks as to how necessary it is to have a long series of specimens before it is possible to determine the limits of a species, are particularly applicable to the protean members of the family *Arctiidæ,* of which the present species is a member, and the test of breeding will also be found to be an essential in such forms. *Leptarctia californiæ* is a rather common and wide-spread, though somewhat local, species in California. It flies in the hot sunshine and seems to have a preference for open plots in wooded localities and along the roadsides. Professor French, in his paper already alluded to, has fully described the preparatory stages, there being but one brood a year. The food-plant is *Pentestemon* and Professor French has also fed the larvæ on *Ribes aureum* (Missouri Currant). In fact, the larvæ, like other *Arctians,* should prove to be quite general feeders. About San Francisco Bay, the adult insect emerges in late April and May. I have taken specimens in the Sierra Nevadas in Placer County, early in April.

REVIEWS.

Meunier, F. Monographie der Leptiden und der Phoriden des Bernsteins. Jahrb. d. königl. Preuss. Geolog. Landenanstalt, Vol. 30, pp. 64–90, pls. 3–7. Berlin, 1909.

Meunier has given in the present paper descriptions of a number of species of Leptidæ and Phoridæ (principally the latter) occurring in Baltic Amber. Of Leptidæ, he recognizes two genera, *Leptis* and *Atherix,* seven species of the former and three of the latter, while in the Phoridæ three genera are recorded, *Phora, Aphiochæta* and *Conicera* with fourteen, five and one species respectively. A comparison of the Phorids with recent species is rather difficult as their describer fails to mention many of the characters used for the separation of living forms, and lays great stress upon the comparative length of the tarsal joints which have not been hitherto extensively used in the classification of recent species.

There are several species, however, which are of especial interest. One, *Phora vincta* Meun. resembles greatly in the armature of the legs, species of the section *Dorniphora* Dahl, represented in both the American and the Malayan regions and the antiquity of this very minor group may explain its present wide distribution. Another, *Phora concinna*[1] has a peculiar flattened space on the hind tibia resembling a structure seen in certain Platypezidæ and Dolichopodidæ, but known among the Phoridæ only in three species of Aphiochæta (*A. smithii* Brues from America and *A. hirtiventris* Wood, and *A. derasa* Wood from Europe). Five tolerably well executed plates accompany the paper. C. T. Brues.

Banks, Nathan. Catalogue of Nearctic Spiders. Bull. U. S. National Museum, No. 72, pp. 80. Washington, 1910.

The little attention which systematic zoölogists have bestowed upon spiders in this country has undoubtedly been due in great measure to the lack of a satisfactory catalogue of the group. This want has been filled in the present paper which should serve to call the attention of entomologists to this interesting group of Arthropods as well as to furnish them with some basis for taxonomic work. Although, as the author says, the catalogue presents no changes in nomenclature or classification it cannot fail to find a field of usefulness. Over 1300 species are included, belonging to nearly 275 genera in 28 families. C. T. Brues.

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[1] Not the *Phora concinna* of Meigen (1830) which is a common European species, and entirely different from this one to which Meunier inadvertently gives the same name.

Howard, L. O. Preventive and Remedial Work against Mosquitoes. Bull. U. S. Bureau of Entomology, No. 88, pp. 126 (June, 1910).

This is a very complete account of the methods of mosquito prevention and destruction, and also contains a most instructive account of the results accomplished by mosquito crusades in a number of countries. Attention is called particularly to the fact that while the United States has done much toward exterminating mosquitoes in Cuba and the Canal Zone, measures relating to mosquito control within its own territory have been received with most deplorable indifference. C. T. Brues.

Snodgrass, R. E. The Anatomy of the Honey Bee. Bull. U. S. Bureau of Entomology, Tech. Ser., No. 18, pp. 162, fig. 57.

Aside from its especial usefulness to those interested in bee-keeping, the present account will be of value to many others on account of its most excellent illustrations and good descriptions of both the external and internal anatomy. The several parts of the paper are preceded by short general considerations of the structure of more generalized insects, which will serve to make the whole intelligible to those unfamiliar with insect anatomy. C. T. Brues.

Forbes, William T. M. A Structural Study of Some Caterpillars. Ann. Entom. Soc. Amer., Vol. 3, No. 2, pp. 94–132, pls. X–XX.

This is a systematic account of the characters present in the caterpillars of a large series of Lepidoptera belonging to many families. The major part of both text and illustrations deals with the comparative external anatomy of the head and the disposition of its setæ, although some attention has been given to the body setæ and armature of the prolegs. The author finds many useful classificatory characters and reaches a number of conclusions regarding the phylogeny and relationships of certain of families and genera. C. T. Brues.

Muttkowski, Richard A. Catalogue of the Odonata of North America. Bull. Public Museum, Milwaukee, Vol. I, pp. 207.

This important catalogue adds another group of considerable size to the series of North American insects which have been listed within the past few years and forms a welcome addition. Although the list primarily includes only Nearctic species found north of Mexico, a number of Mexican and all Cuban species are included, the southern limit being placed at 20° latitude, which, with a few exceptions, the author believes "closely approximates the natural zoogeographical limit." Such a treatment should avoid the omission of many species found in the southwestern states, as these become more thoroughly explored. Nearly 500 forms are included with full synonymic references and also an extensive series of ethological references. Useful innovations are the citation of the present location of all types, so far as this could be ascertained; the mention of both actual places of capture of species and their zonal distribution; and the listing in a separate series of all fossil species. Matters of nomenclature have been dealt with by a conservative application of the International Zoological Code. C. T. Brues.

Hewitt, C. Gordon. The House Fly; A Study of Its Structure, Development, Biconomics and Economy. pp. ix, 195; pls. 10. Manchester, 1910. Sherratt and Hughes.

Doctor Hewitt has put together in the present book his three valuable papers on the house fly, which appeared in the Quarterly Journal of Microscopical Science during 1907, 1908 and 1909, and has added several short appendices dealing mainly with matters of practical importance. The appearance of this book just at present is very timely, when general interest is awakening in the economic importance of the house fly and it is to be hoped that Doctor Hewitt's fine work may find many appreciative readers. C. T. Brues.

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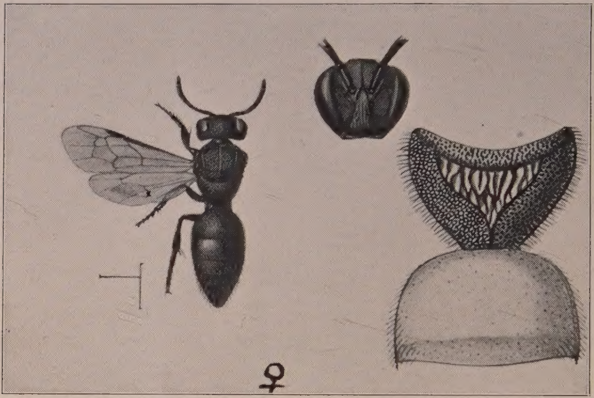

FIG. 1.-- PROSOPIS AFFINIS SMITH.

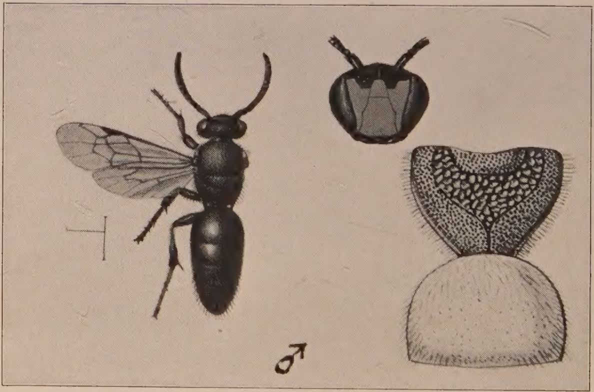

FIG. 2.-- PROSOPIS BINGHAMI LOVELL.

LOVELL -- PROSOPIDIDAE OF SOUTHERN MAINE.